Great Plains

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Plant Species Adaptability on Mine Spoils, in the Southwest: A Case Study[1]

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Five native plant species and one introduced species showed high survival rates (67% to 100%), good vigor, and some spreading 6 years after transplanting on raw mine spoil.

Keywords: Mine reclamation, mine spoils, grasses, shrubs

Techniques for establishing vegetation on mine spoils resulting from the surface mining of coal in the Southwest are advancing rapidly (Aldon 1978, and USDA Forest Service 1979). These techniques have been worked out for a few key native species of both economic and agronomic importance for reclaimed lands (Aldon 1978). However, both state and federal regulations now require that a wide variety of species be reestablished after mining (USDI Office of Surface Mining 1979). To help meet these requirements, a series of species adaptability studies was installed on several mined sites in the early 1970's. Such studies are long term; some argue that plant adaptability in the Southwest isn't certain for 5 or more years (Lavin and Johnsen 1977). However, because reclamation specialists must conform now to requirements set down by law, the need for adaptability information is especially acute.

This note presents the results of a study established in 1973 to evaluate the adaptability of several native grass and shrub species, at the McKinley mine, in west-central New Mexico.

Study Area

The McKinley Mine, 20 miles northwest of Gallup, operates in the Gallup Mesaverde coal field. The climate is semiarid. Annual precipitation averages 10 to 14 inches, a third of which falls as high-intensity rains in July and August. Another third falls as snow from December through March. Dry, windy weather prevails during the spring (< 1.5 inch of precipitation, April-June). Elevation ranges from 6,800 to 7,300 feet. Temperatures reach extremes of -35° to 95° F. Pinyon (*Pinus edulis*)-juniper (*Juniperus monosperma*) woodland is the dominant vegetation, occupying the plateaus, benches, mesas, rocky breaks, and steeper slopes. Associated with the trees are several shrubs, such as mountainmahogany (*Cercocarpus montanus*) and cliffrose (*Cowania mexicana*), and a sparse herbaceous understory, including squirreltail (*Sitanion hystrix*). The relatively narrow valleys filled with moderately deep alluvium support big sagebrush (*Artemesia tridentata*) with an understory mainly of western wheatgrass (*Agropyron smithii*) and blue grama (*Bouteloua gracilis*).

[1]*The research reported here is a contribution to the SEAM program. SEAM, an acronym for Surface Environment and Mining, is a Forest Service program to research, develop, and apply technology that will help maintain a quality environment and other surface values while helping meet the Nation's mineral requirements.*

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All plantings in this study were made on unamended spoil material from mining completed in 1969. Spoil characteristics are listed in table 1.

Methods

In August 1973, 14 species of native and introduced perennials listed in table 2 were transplanted at the mine. All seedlings were grown in asphalt-impregnated, paper plant bands which were removed before transplanting. The seedlings were transplanted with soil intact, and were watered in. The transplants were 3-month-old stock. The plot was fenced initially to exclude livestock and game, but fence integrity, at least against rabbits and small rodents, was not maintained. No additional water was provided.

Initial survival was checked in November 1973, and in October or November of 1974, 1978, and 1979.

Because of limited planting stock, some species were not adequately tested, and the limited results are given here for general information only.

Results and Discussion

Of the 14 species tested, 5 native and 1 introduced species have shown considerable promise. These six have high survival rates (67% to 100%), good vigor, and spread by seed or rhizomes into adjacent areas (table 2). The three successful rhizomatous grasses, galleta, western wheatgrass and inland saltgrass, are not highly aggressive, but are spreading slowly, even under the unfavorable but normal rainfall of recent years (table 3). Rubber rabbitbrush and fourwing saltbush are vigorous, averaging between 2 and 3 feet tall, and about 2 feet diameter. Progeny seedlings, while limited, show good vigor, and may be expected to ultimately influence the aspect of the surrounding hillsides. The introduced kochia appears most successful of the shrubs to date, with numerous second and third generation progeny surrounding the test plots. This kochia does not appear weedy, however, and may be worth further testing. Original plants average 13 inches tall and 20 inches diameter (fig. 1).

Transplanting using potted plants was successful with all species except spiny hopsage. The major mortality occurred during the first spring dry period after planting. Plants able to survive this severe drought period apparently were well rooted, and on their way to successful establishment. Sample size of sainfoin, spiny hopsage, and shadscale was too small to be meaningful.

Because of new emphasis on species diversity in reclamation work, additional testing of these and other promising species should continue.

Table 1.—Spoil characteristics at McKinley Mine study site

SAR: 7.21	CEC: 15.0 meq/100 gr
EC: 7.29 mmhos/cm	Na: 35.5 meq/1 Soluble
pH: 6.1	Ca: 25.7 meq/1 Soluble
Organic Matter: 5.1%	Mg: 22.8 meq/1 Soluble
Texture: clay-loam	K: 1.8 meq/1 Soluble
NO_3: 5.6 ppm (1:5 ext.)	Sand: 32.0%
P: 8.8 ppm ($NaHCO_3$ ext.)	Silt: 34.2%
K: 0.24 meq/100 gr (NH_4OAC ext.)	Clay: 33.8%

Table 2.—Success of species transplanted August 23, 1973, on raw spoil, at the McKinley Mine, Gallup, N. Mex.

Species	No. of plants	Percent of original transplants surviving to: Nov. 1973	Oct. 1974	Nov. 1978	Oct. 1979
Rubber rabbitbrush, *Chrysothamnus nauseosus*	8	100	88	88	[1]88
Galleta, *Hilaria jamesii*	7	100	86	86	[2]86
Alkali sacaton, *Sporobolus airoides*	7	100	100	100	100
Blue grama, *Bouteloua gracilis*	6	100	100	17	0
Shadscale, *Atriplex confertifolia*	3	100	67	0	0
Sand dropseed, *Sporobolus cryptandrus*	7	86	0	0	0
Kochia, *Kochia prostrata*	7	71	71	71	[3]71
Sainfoin, *Onobrychis viciaefolia*	2	50	50	0	0
Indian ricegrass, *Oryzopsis hymenoides*	8	38	0	0	0
Spiny hopsage, *Grayia spinosa*	2	0	0	0	0
Western wheatgrass, *Agropyron smithii*	57	100	100	100	[2]100
True mountainmahogany, *Cercocarpus montanus*	12	100	0	0	0
Fourwing saltbush, *Atriplex canescens*	50	80	67	67	[1]67
Inland saltgrass, *Distichlis stricta*	26	38	27	27	[2]27

[1]*Spreading by seedlings. Volunteers are vigorous and well established.*

[2]*Spreading by rhizomes; original plant identity lost.*

[3]*Abundant second and third generation seedlings.*

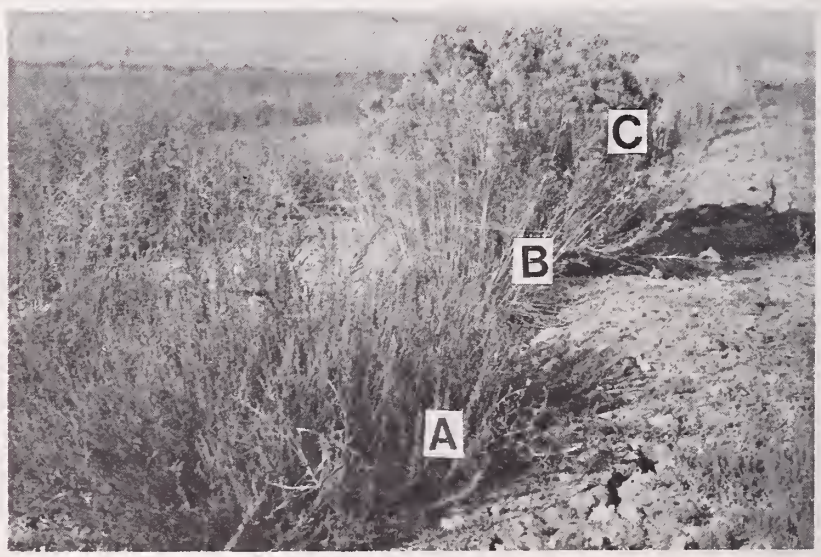

Figure 1.—Vigorous plants of *Kochia prostrata* (A), *Sporobolus airoides* (B), *Chrysothamnus nauseosus* (C) 6 years after transplanting on raw mine spoil at the McKinley Mine.

Table 3.—Precipitation (in inches) at Window Rock, Arizona, 3 miles from the McKinley Mine trial planting site

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1973	0.60	1.26	2.02	0.73	0.96	0.79	1.65	1.48	0.41	0.36	0.69	1.00	11.02
1974	1.44	.39	.19	.44	0	.18	2.90	.17	1.92	3.68	.39	.07	11.98
1975	1.09	1.12	1.61	.59	.09	0	3.87	.62	2.95	0	.80	.28	13.55
1976	.19	.80	.13	.54	.70	.17	2.72	.97	.71	.32	.07	.81	7.46
1977	.38	.61	.95	.13	.25	.52	1.23	2.94	1.14	.49	1.05	.14	10.00
1978	.51	.96	1.64	.28	1.67	0	1.12	1.24	1.10	—	2.78	.31	—
1979	1.64	—	1.45	—	.86	.85	0	.82	.01	.92	.94	1.69	—

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